

A stylized illustration of a road curving to the right. The road is dark asphalt with white dashed lane markings and a solid white edge line. On the left side of the road, there is a yellow curb and some greenery. On the right side, there is a grassy shoulder and a dense line of green trees. Two blue rectangular signs on white poles are visible on the right side of the road. The overall style is that of a digital illustration or graphic design.

NCAT Test Track Research Update

Pennsylvania Asphalt Pavement Association Annual Conference

Randy C. West

An aerial photograph of a large asphalt proving ground. The road is a long, winding loop that curves through a dense forest of trees with varying shades of green and brown. In the lower-left corner, there is a construction area with several buildings with green roofs and a large pond. In the lower-right corner, there is a parking lot with several cars and a building with a green roof. The road itself is a multi-lane highway with white lane markings and a dark asphalt surface.

*America's
Asphalt Pavement
Proving Ground*

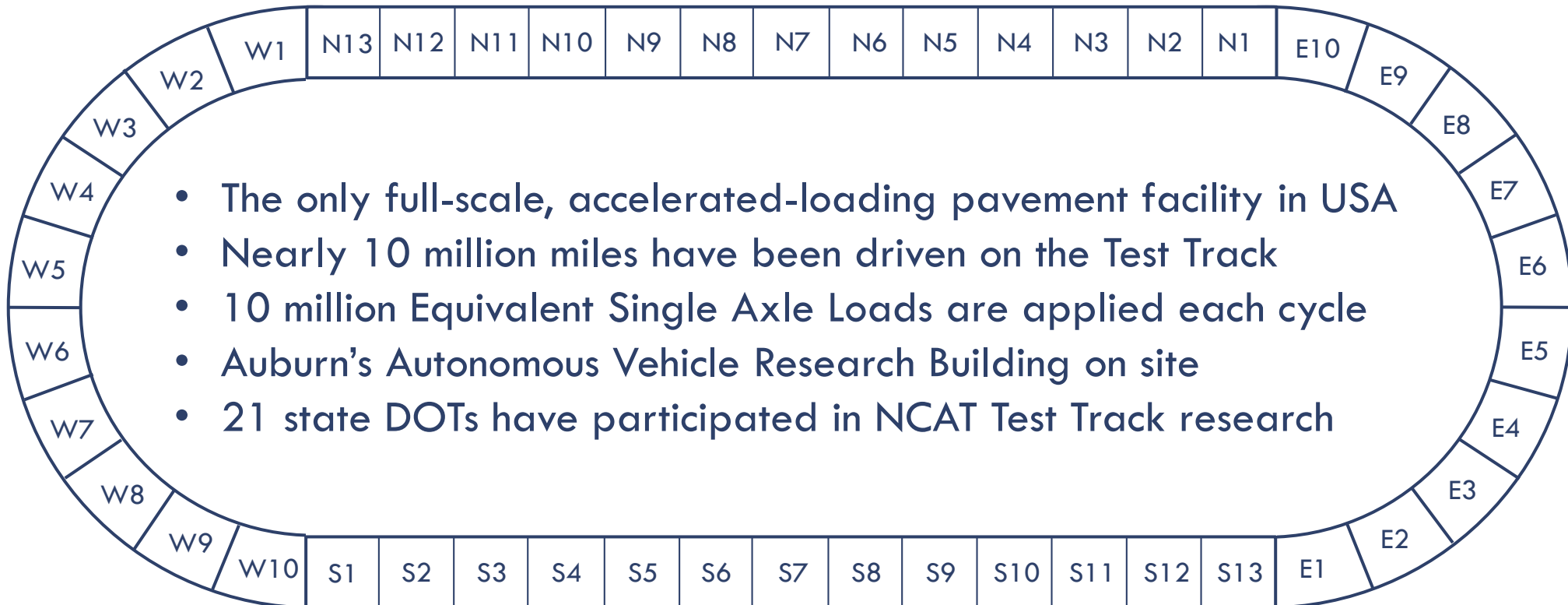
Turnkey Research





- Test sections are evaluated continuously over 3 year cycles
- 2021 began our 8th cycle
- 46 Test Sections, 200 ft. each
- 5 trucks each pulling 3 heavily loaded trailers make 400 laps/day

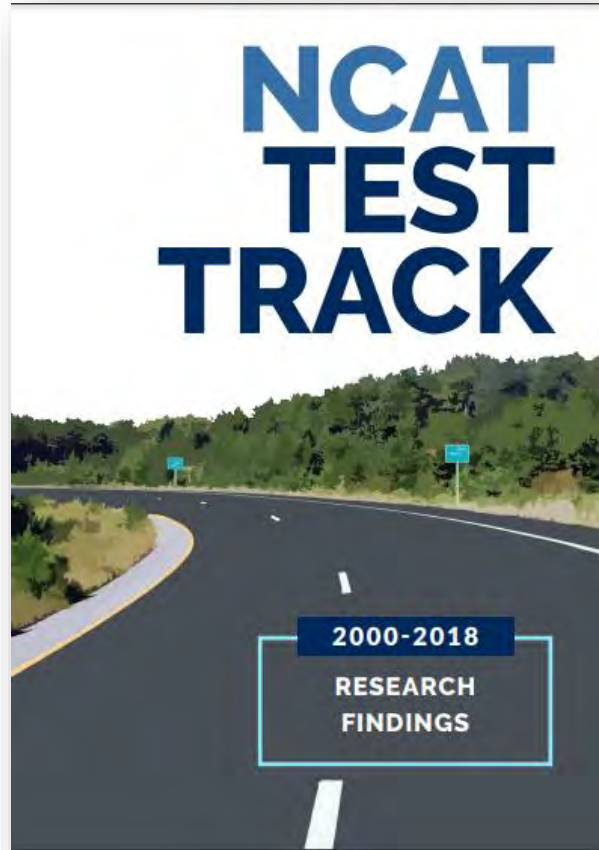
NCAT Test Track Facts



A stylized illustration of a two-lane asphalt road curving to the right. The road is dark grey with white dashed lines in the center and a solid white line on the right edge. A yellow curb is visible on the left side of the road. The background consists of a dense forest of green trees and bushes under a white sky. Two blue rectangular signs on white poles are positioned on the right side of the road, one further ahead than the other.

Findings from 20 years of Test Track Research

For more information...visit: www.ncat.us



Since the results of experiments are typically evident in the performance of the sections, the findings are generally easy to interpret. This gives highway agency sponsors confidence to make decisions regarding their specifications, construction practices and pavement design methods that can improve the performance of their roadways. Industry sponsors use the track to publicly and convincingly demonstrate their technology to the pavement engineering community.

Types of Test Track Experiments

An aerial photograph of a test track. A white truck is driving on the track, followed by a smaller car. The track is surrounded by dense green trees and vegetation. The text is overlaid on the top half of the image.

1. Structural Experiments

- Full-depth reconstruction of cross-section
- Instrumented with stress & strain sensors and temperature probes.
- FWD testing throughout experiment

2. Surface-layer Experiments

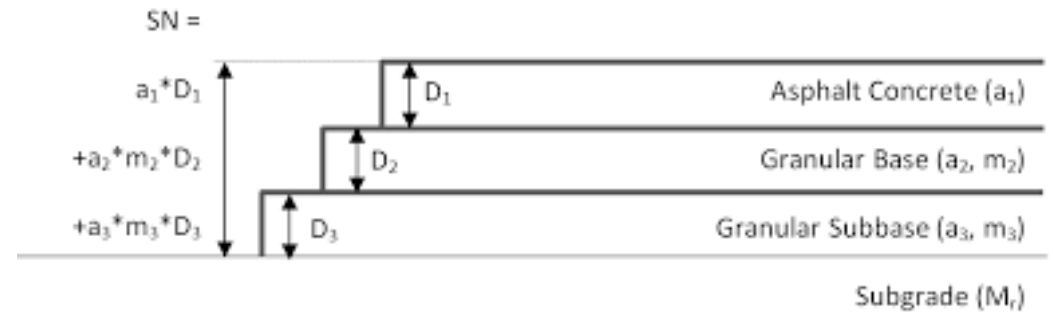
- Only upper layer(s) replaced
- No instrumentation



Structural Experiments

Revised Asphalt Layer Coefficient, a_1

- 1993 AASHTO Pavement Design Guide
- Analysis based on...
 - ✓ Lab Modulus
 - ✓ Field deflections and backcalculation
 - ✓ Field Performance

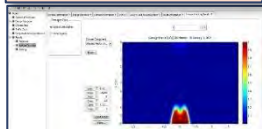
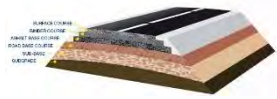


Implemented in Alabama in 2010
Annual Savings between \$25 and \$50 million

NCAT Report 14-08

RECALIBRATION PROCEDURES FOR THE
STRUCTURAL ASPHALT LAYER COEFFICIENT IN
THE 1993 AASHTO PAVEMENT DESIGN GUIDE

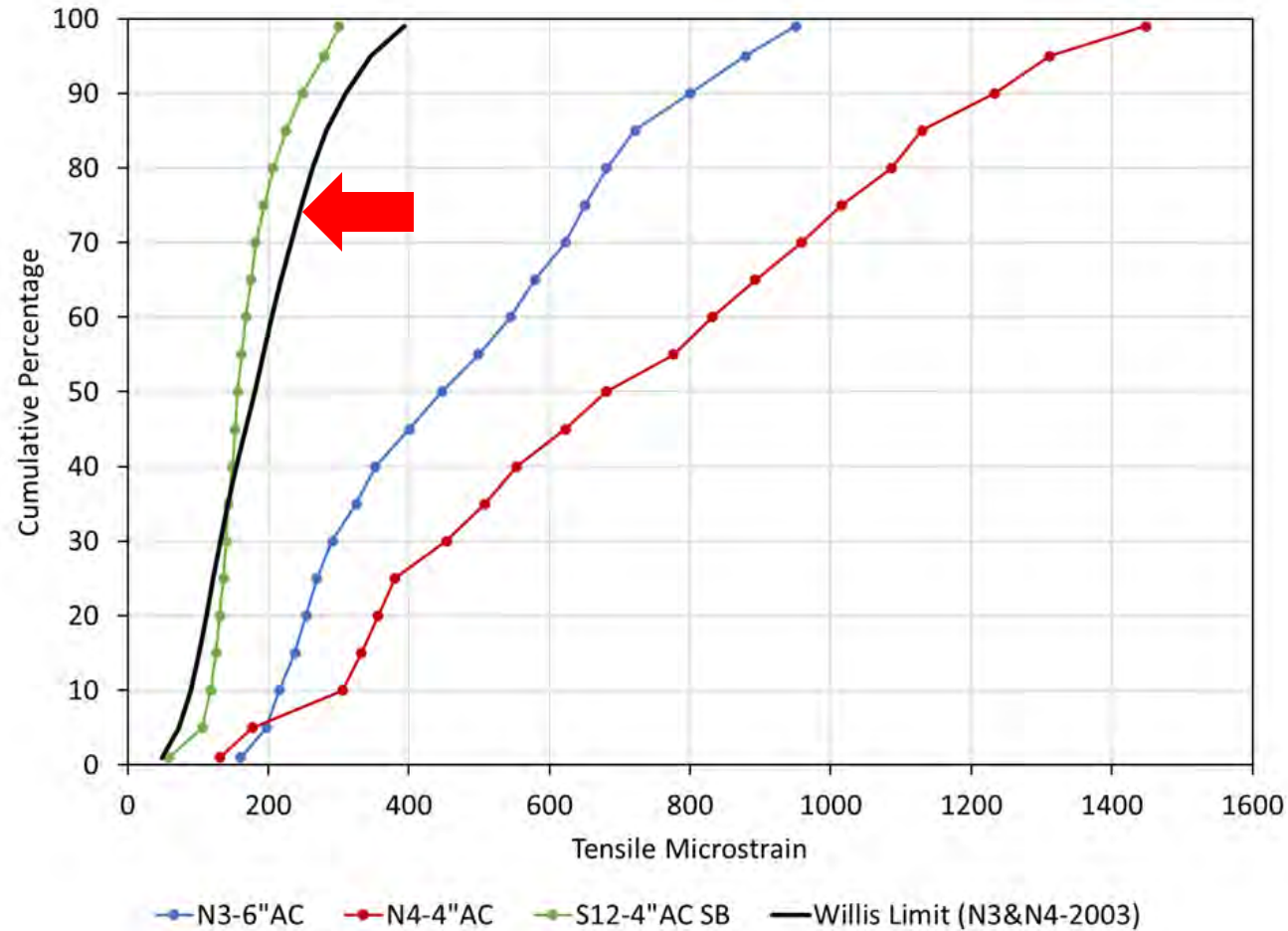
Mechanistic-Empirical Design Procedures



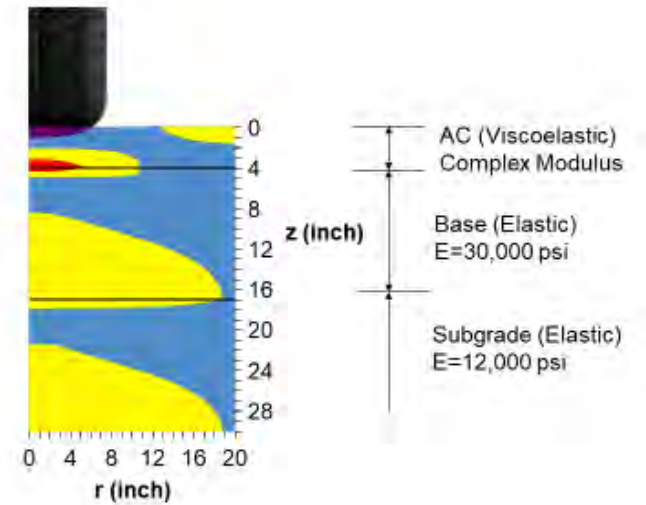
- All of these programs have used NCAT test sections for model calibration.
- MEPDG over-predicted rutting by 50-100% using default national calibration coefficients.
- MEPDG fatigue prediction was poor even after adjusting coefficients.
- Several non-traditional asphalt mixtures and other materials have been validated.

NCAT Test Track

Perpetual Pavement Strain Distributions

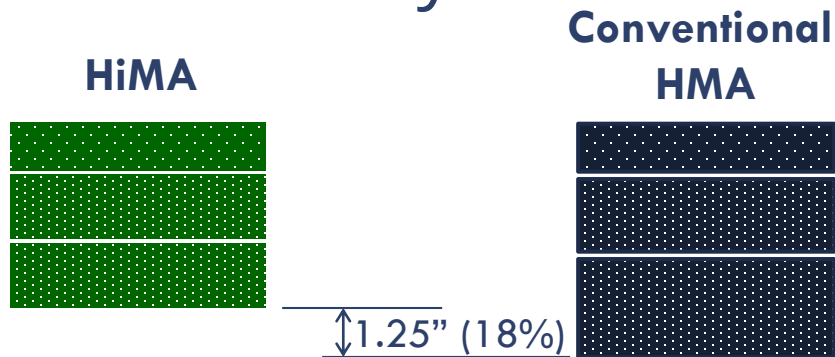


Tensile Stress



Highly Modified HMA Structural Assessment

- 5.75 inches vs 7 inches
- Same mix designs in surface, intermediate, and base layers



- Control section: 10% of lane area fatigue cracking
- HiMA section: 6% of lane area top-down cracking



Cold Central Plant Recycling

Other Structural Experiments



Cement and lime stabilized layers



Thick, Single-Lift Reconstruction

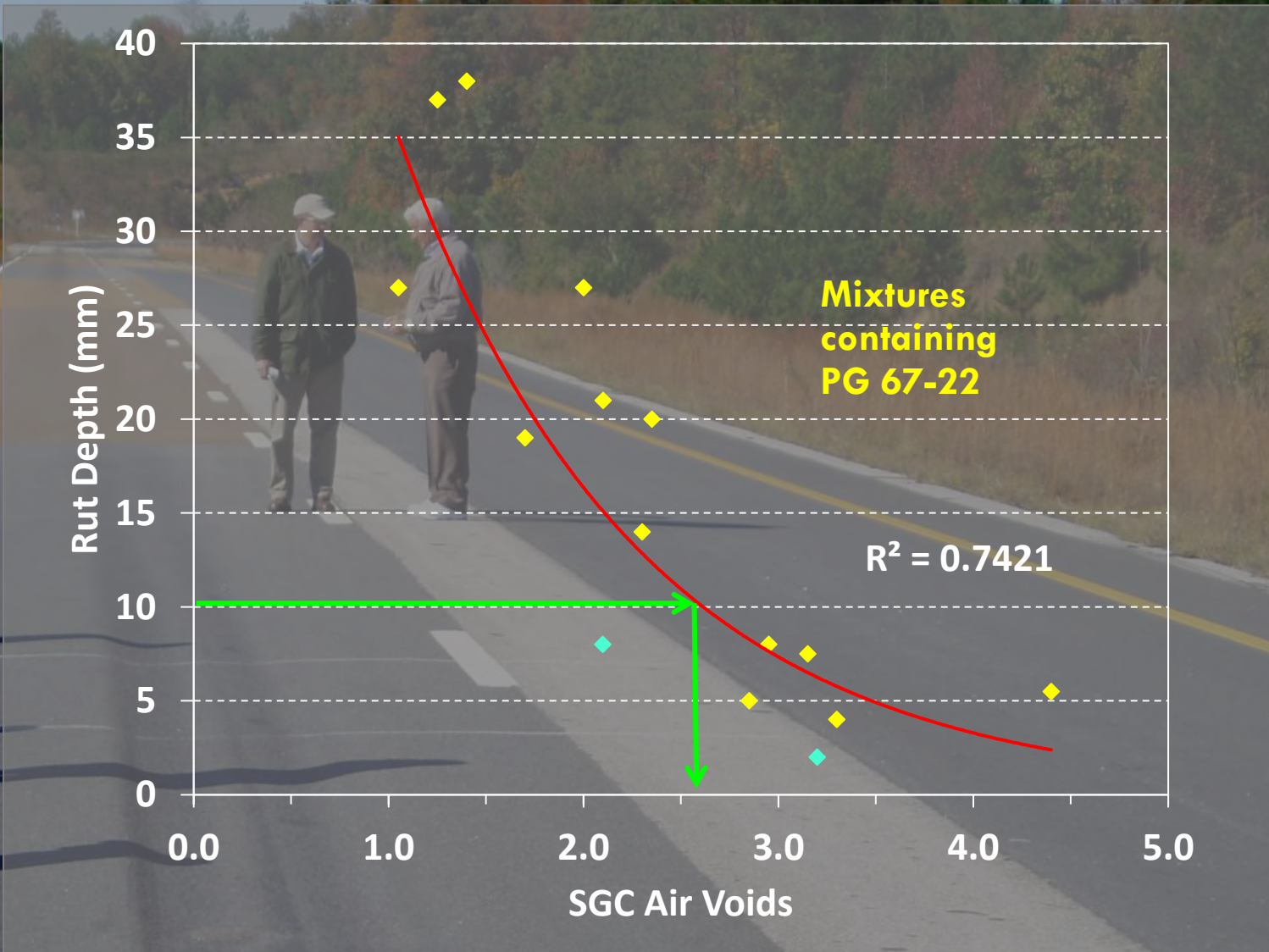
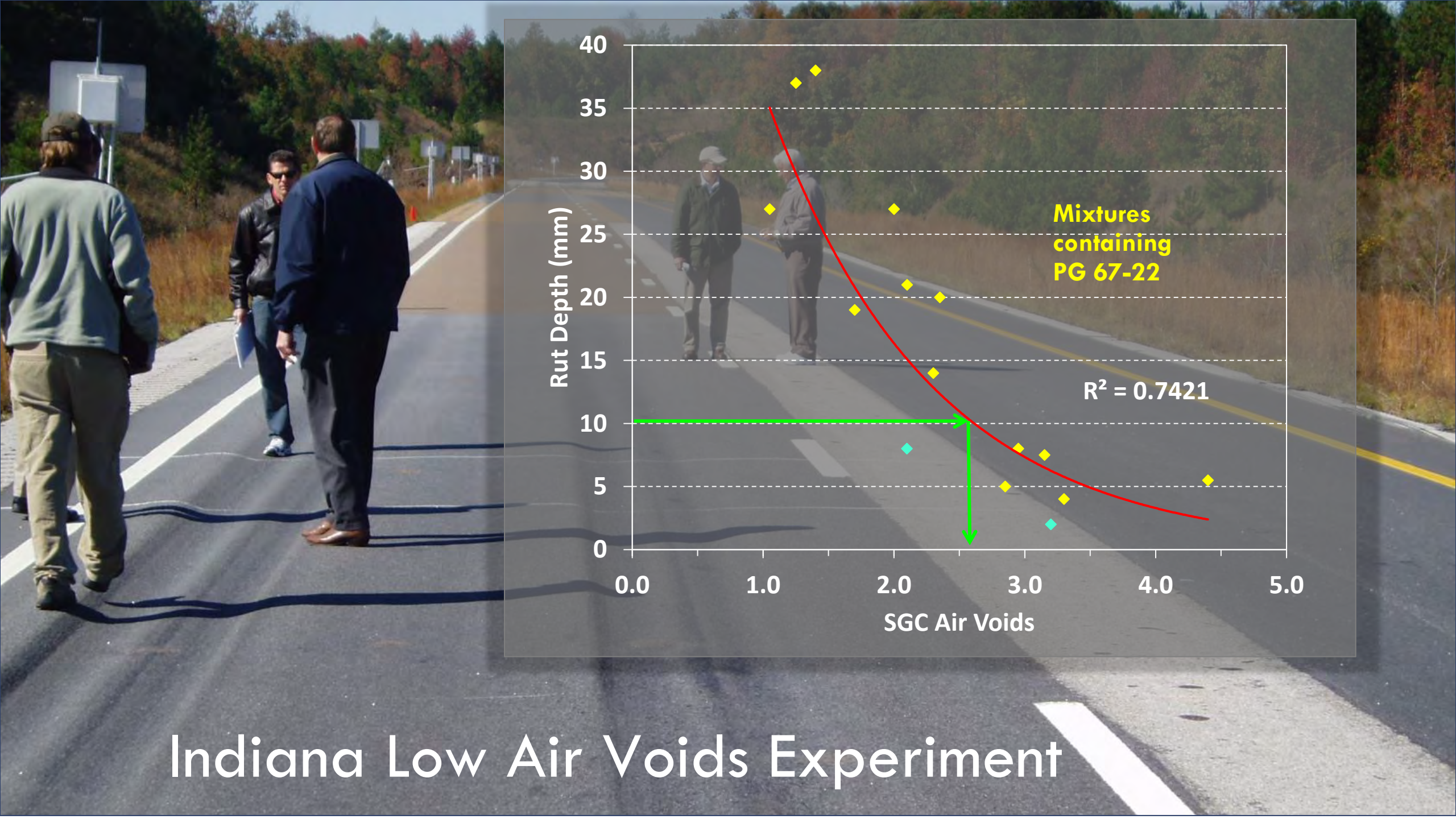
Surface Mix Experiments



Refinements to Mix Design Specifications

- Fine and coarse Superpave mixes perform similarly regardless of aggregate type
- PG 76 vs PG 67 - reduces rutting approximately 50%
- Dense-graded as rut resistant as SMA, but SMA is more durable
- Lowering N_{design} is OK
- 50% RAP mixes perform equal to virgin mixtures in all layers





Indiana Low Air Voids Experiment

Aggregate Specifications



- ❑ Elimination of the Restricted Zone
- ❑ Evaluation of marginal aggregate
- ❑ Gravel suitability in SMA & OGFC
- ❑ Higher F&E content for SMA & OGFC
- ❑ Maximum limestone content for friction

NCAT Test Track

Cracking Group Experiment

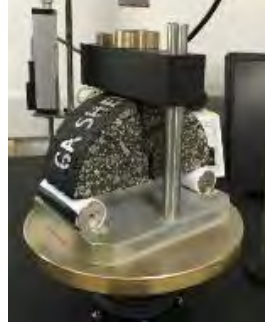
Which Tests Correlate to Field the Best?



Energy Ratio



SCB-LA



I-FIT



OT-TX



OT-NCAT



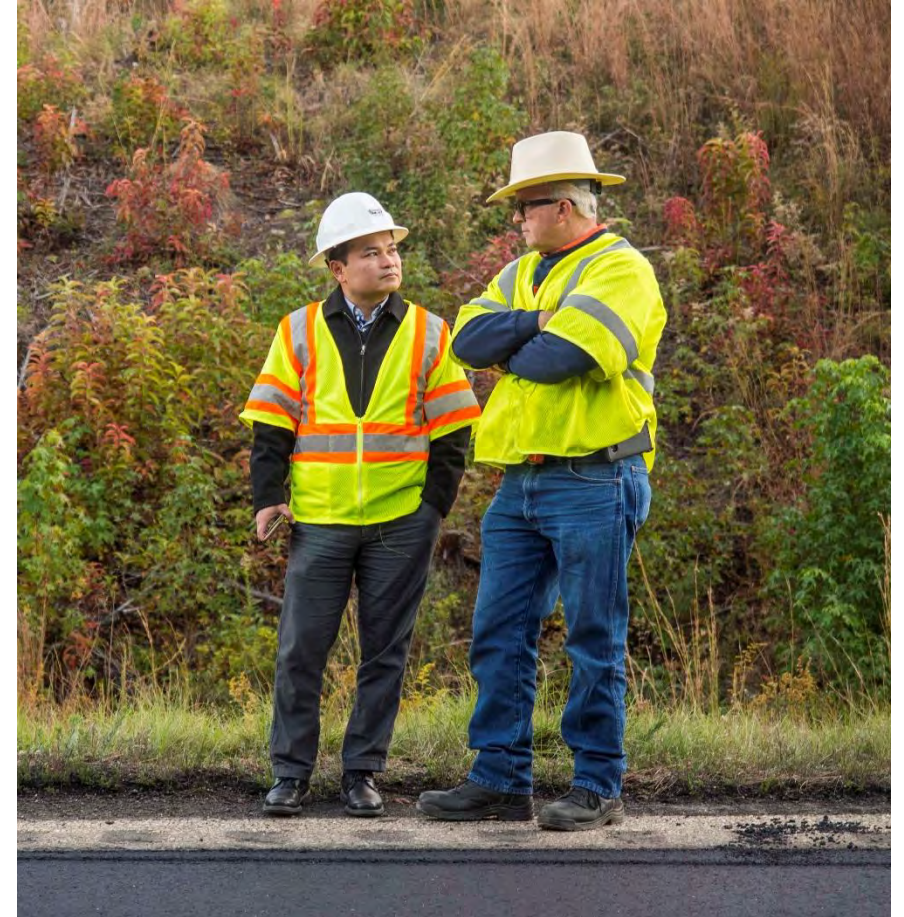
IDEAL-CT



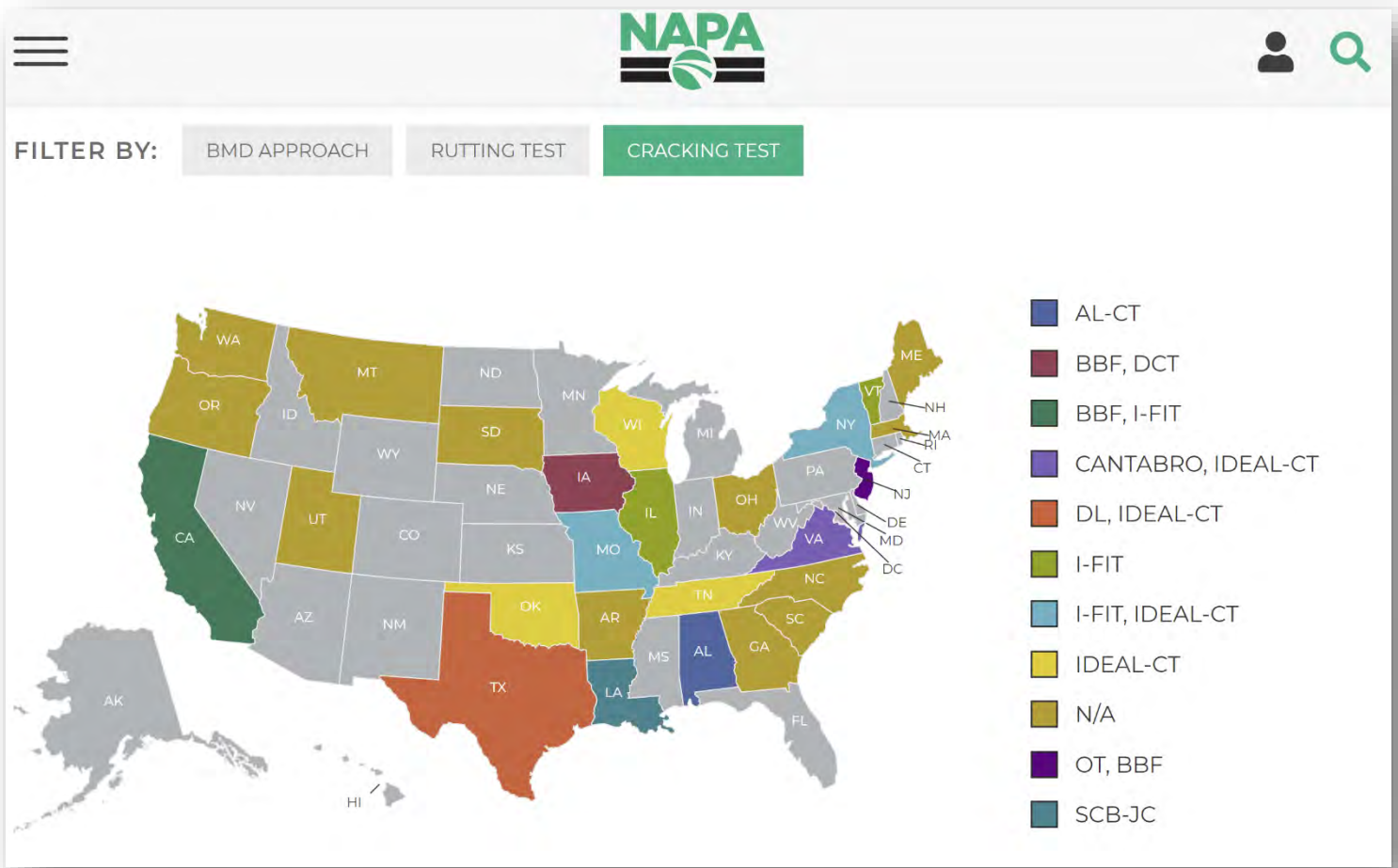
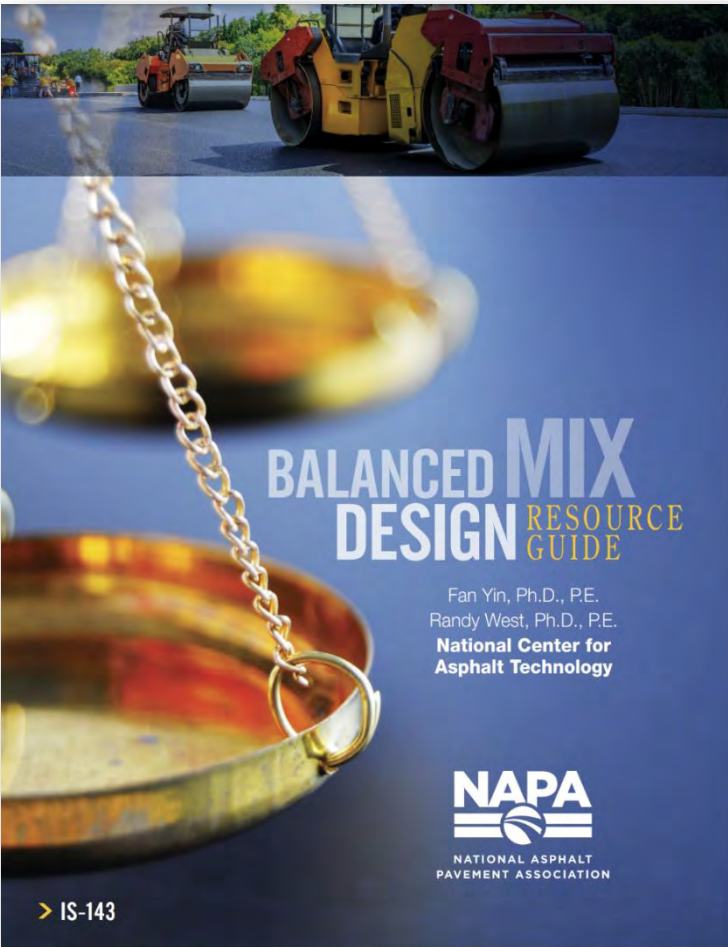
*AMPT
Cyclic Fatigue*

Balanced Mix Design

- ❑ Comparison of BMD vs. Superpave
- ❑ Preliminary validation of BMD criteria
- ❑ Evaluation of innovative additives for improving mix performance and increasing sustainability
- ❑ Combining BMD and friction assessment for surface layers



NCAT Test Track



BMD Resources

Scan this code or visit aub.ie/bmd for useful resources related to balanced mix design



The Bucket Brigade



An aerial photograph showing a large-scale road construction project. A prominent feature is a wide, multi-lane road that forms a large loop or curve, cutting through a dense forest. The road surface is light gray, with some sections appearing darker, possibly indicating different materials or stages of construction. Several vehicles, including trucks and cars, are visible on the road. To the right of the road, there is a developed area with several buildings, including one with a green roof, and a parking lot filled with cars. The surrounding forest is a mix of green and brown trees, suggesting a transition in seasons. The overall scene depicts a major infrastructure project in a wooded area.

**Overview of the
NCAT & MnROAD
Additive Group Experiment**

Additive Group Experiment

- A new experiment to comprehensively evaluate sustainable and resilient pavement technologies
- Continuation of the partnership between NCAT and MnROAD to address national needs



NCAT Test Track



MnROAD



NCAT Additive Group Sponsors



Overall Additive Group Plan



State DOTs commit to sponsoring the AG experiment



NCAT conducts Phase I lab study to evaluate potential additive products



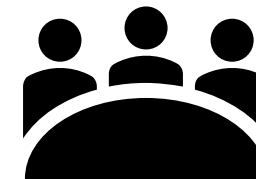
NCAT shares Phase I results with state DOTs



Construct AG test sections on MnROAD



Construct AG test sections on Test Track



State DOTs select additives for the AG experiment

Phase 1 Additive Technologies

Recycled Tire Rubber



Recycled Plastics



Fibers



SURFACE TECH



Superior Asphalt Performance



Phase 2 Additive Technologies

Recycled Tire Rubber



wet process



dry process

Recycled Plastics



wet process

Brand X LDPE rich

dry process

Fibers

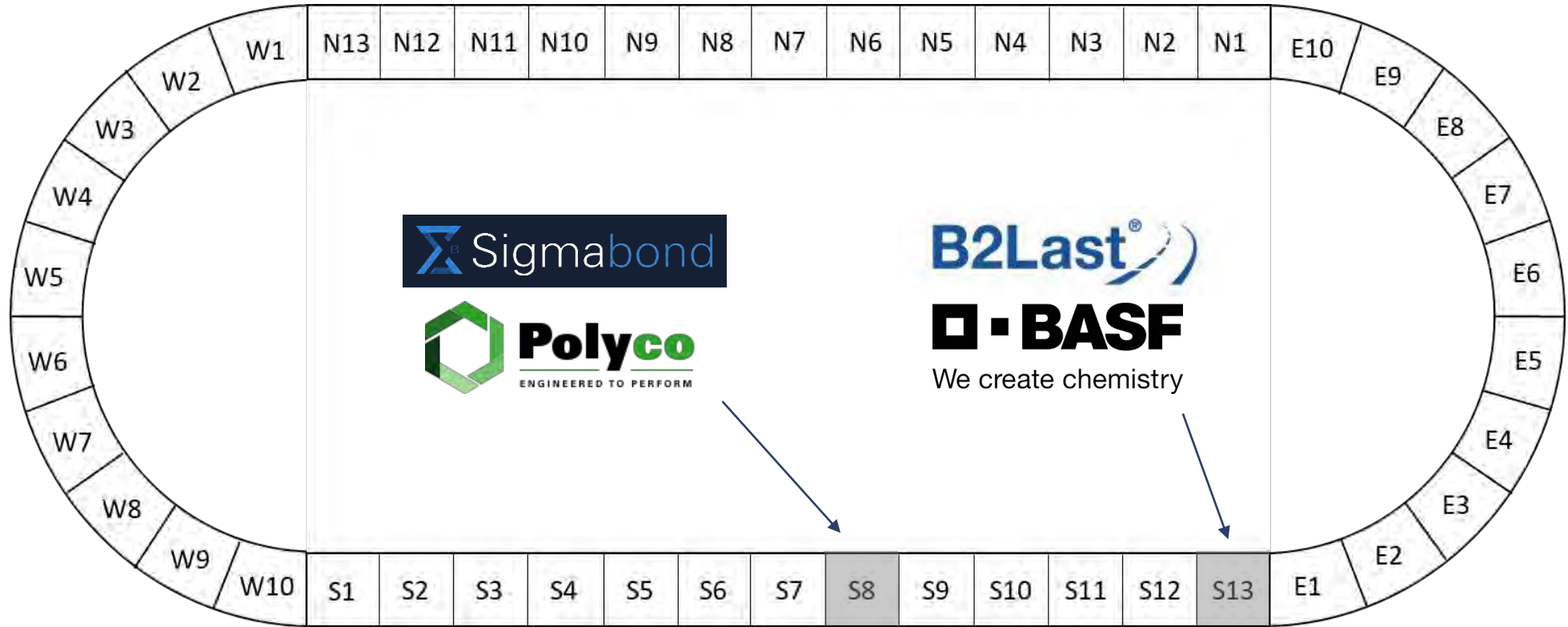
SURFACE TECH™



Superior Asphalt Performance

NCAT Test Track

Complementary Sections

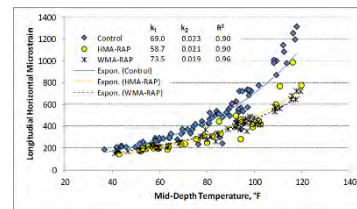


Additive Group Experimental Scope

Performance Data



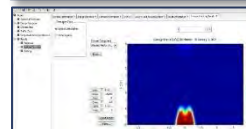
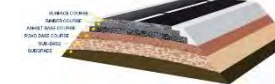
Structural Response



Materials Characterization



Pavement Design



NCAT Additive Group Experiment Design

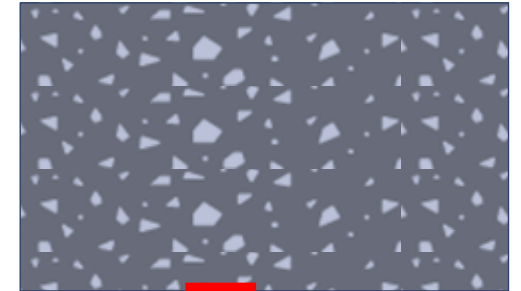
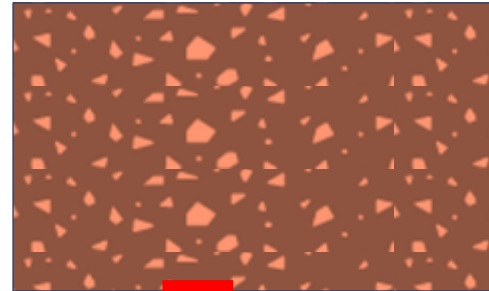
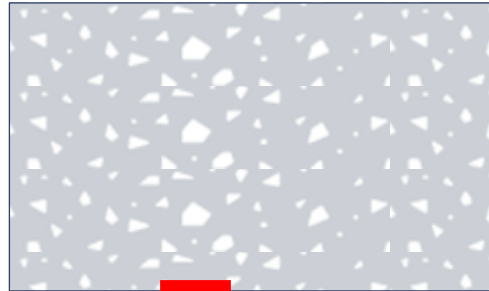
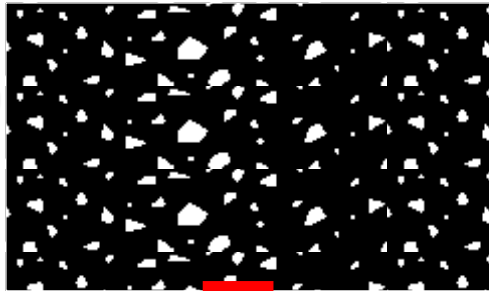
Control

Additive 1

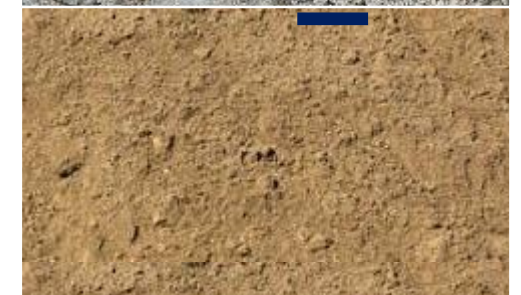
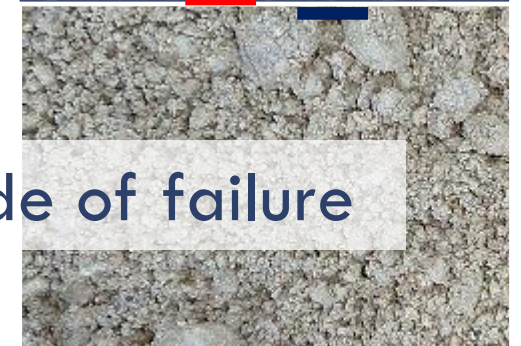
Additive 2

...

5.5"



6"



Bottom-up fatigue cracking is the designed mode of failure

Build & Evaluate AG Test Sections



N1 – Entech wet process GTR



N2 – Liberty SmartMix



N5 – ACE Fibers



S6 generic "LDPE rich" dry plastic



S7 Dow wet plastic



S13 B2Last



Construction QA Results

	Target	Control	Dry rubber	Wet rubber	Dry plastic	Wet plastic	Fibers
Section		N7	N1	N2	S5	S6	N5
P_b (%)	5.6	5.7	5.6*	5.8	5.8	5.7	5.5
$P_{2.36}$	41	41	45	42	43	42	40
$P_{0.075}$	4.3	4.0	4.3	4.1	3.8	4.0	3.8
Hot Comp. CT_{Index}		101	64	41	40	74	94
Hot Comp. RT_{Index}		85	91	128	144.3	83	98
In-Place Density	> 93.0	95.9	93.7	94.1	93.5	93.9	94.2

Questions and Answers

